STATE OF ALASKA

Bill Sheffield, Governor

Annual Performance Report for

A STUDY OF LAND USE ACTIVITIES AND THEIR RELATIONSHIP TO THE SPORT FISH RESOURCES IN ALASKA: COHO WINTER SURVIVAL

by

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RESEARCH PROJECT SEGMENT

State: Alaska Name: Sport Fish Investigations of Alaska

Project: F-10-1

Study: S-1 Study Title: ANADROMOUS SALMON STUDIES

Job: S-1-2A Job Title: A Study of Land Use Activities and Their Relationship to the Sport Fish Resources In Alaska: Coho Winter Survival

Cooperators: Steven T. Elliott and Roger D. Harding

Period Covered: 1 July 1985 to 30 June 1986

ABSTRACT

A third year of research on the effects of clear-cut logging on the winter survival of juvenile coho salmon was conducted at Kake Bake Creek, Kupreanof Island, from August 1985 to June 1986. Abundance, movement, and survival rate of juveniles in the estuarine, old-growth forested, and clear-cut logged portions of the watershed were estimated and compared.

Based on the recovery of marked fish, about 90% of the estuarine-reared fish migrated upstream during the fall and resided in forested and clear-cut logged sections by November. Only 26% of the fish in the forested section moved to other locations, and less than 5% of the clear-cut reared fish were found in different stream sections.

Juvenile abundance was similar in the forested and logged sections of stream during August, November, and March. The survival rate of juveniles from November through March averaged 59% in the clear-cut reaches and 33% in the forested reaches; these values are not significantly different (one-way ANOVA; $P<0.05$).

These conclusions are preliminary, pending the completion of data collection and analysis. Final reports will be published in cooperation with the Auke Bay Laboratory, National Marine Fisheries Service, and the Forestry Sciences Laboratory, U.S.D.A Forest Service.

KEY WORDS

Clear-cut logging, old-growth forest, southeast Alaska, survival, migration, coho salmon, *Oncorhynchus kisutch*.

BACKGROUND

In 1984 the Alaska working group on Cooperative Fishery-Forestry Research, of which this project is a member, began research on the effects of clear-cut logging on the winter survival of juvenile coho salmon. From July 1983 to June 1984, research staff from the Auke Bay Biological Laboratory (National Marine Fisheries Service), Forestry Sciences Laboratory (U.S.D.A. Forest Service), and this project conducted work at Deer Track Creek, Prince of Wales Island and Kake Bake Creek, Kupreanof Island (Elliott and Hubartt 1984). Work was repeated at Kake Bake Creek from July 1984 to June 1985; no work was done at Deer Track Creek. During this period, the Land Use Study was not funded, and the contribution to the winter survival program consisted of field support. No information on this phase of the project is available.

The first 2 years' work at Kake Bake Creek suggested that populations increased in both clear-cut and logged sections of the stream during November, a result of immigration of estuarine-origin fish. Juveniles in the clear-cut section of the stream may have accessed a system of beaver ponds and enjoyed a high winter-survival rate. This gives the perception that all clear-cut fish had high winter survivals. To resolve these two questions, this project conducted a third year of research. Preliminary findings of that work are summarized in this report.

A list of common and scientific names of all species referred to in this report is contained in Table 1.

RECOMMENDATIONS

Preliminary findings of this year's work corroborates findings in 1984 and 1985: if habitat quality is maintained, there is no significant effect of logging on winter mortality of juvenile coho salmon. Consequently, these studies have achieved their goals and the project should be discontinued. Findings by the project should be published in cooperation with the Alaska Working Group on Fishery-Forestry Research. Research on the effects of logging, however, is not complete.

Elliott (1985) reviewed pertinent literature and recommended the following:

1. Research on rearing coho salmon life history in relation to logging is near completion. However, it would be advisable to investigate winter-survival parameters in the Haines area, where winter conditions are thought to be the most severe.

Table 1. List of Common Names, Scientific Names, and Abbreviations.

Common Name	Scientific Name and Author	Abbreviation
Coho salmon	*Oncorhynchus kisutch* (Walbaum)	SS

2. Studies should be developed to determine if temperature-related phenomena observed at Carnation Creek, British Columbia, are occurring in southeast Alaska.

3. Studies should be developed to examine changes in stream morphometry after logging and determine if salmonid egg-fry survival and carrying capacity are affected.

4. Studies should be developed to determine the longevity and recruitment rate of woody debris in disturbed and undisturbed streams.

5. Buffer zones are the superior method of protecting stream habitat in clear-cuts. Research to establish design criteria for this technique is needed.

6. Active debris management is highly favored by forest managers in lieu of buffer zones. Better research is needed in southeast Alaska to develop criteria for these techniques.

OBJECTIVES

1. Determine if there is a difference in winter survival of juvenile coho salmon in logged and forested stream environments by comparing their survival rates from 1 August 1985 to smoltification (15 June 1986).

METHODS

Study Site

Kake Bake Creek, Kupreanof Island, is located approximately 24 km southeast of Kake, Alaska and flows into Big John Bay (Figure 1). The stream is tannic stained, drains a small beaver-dam complex, and varies in width from 1 m in the upper headwaters to 10 m near the mouth. The stream has a large intertidal zone, and high tides often inundate the stream for a considerable distance upstream. The upper half of the watershed was clear-cut logged in 1976.

Sampling Design

Kake Bake Creek was divided into three treatment sections: (1) estuarine zone; (2) old-growth forested stream zone; and (3) clear-cut logged stream zone (Figure 2). Within each treatment section, the stream was divided into 50-m-long sample reaches. Estimates were made of the juvenile coho population in August, November, and March in each reach within each treatment. The mean population size and survival rate among treatments was calculated and compared. Habitat measurements were taken in August and March and compared to population sizes and survival rates. To estimate smolt production among treatments, traps were built in March 1986 to capture fish emigrating from the slough/beaver ponds, upper portion of the clear-cut, the entire clear-cut, and the old-growth forested portion of the stream (Figure 2).

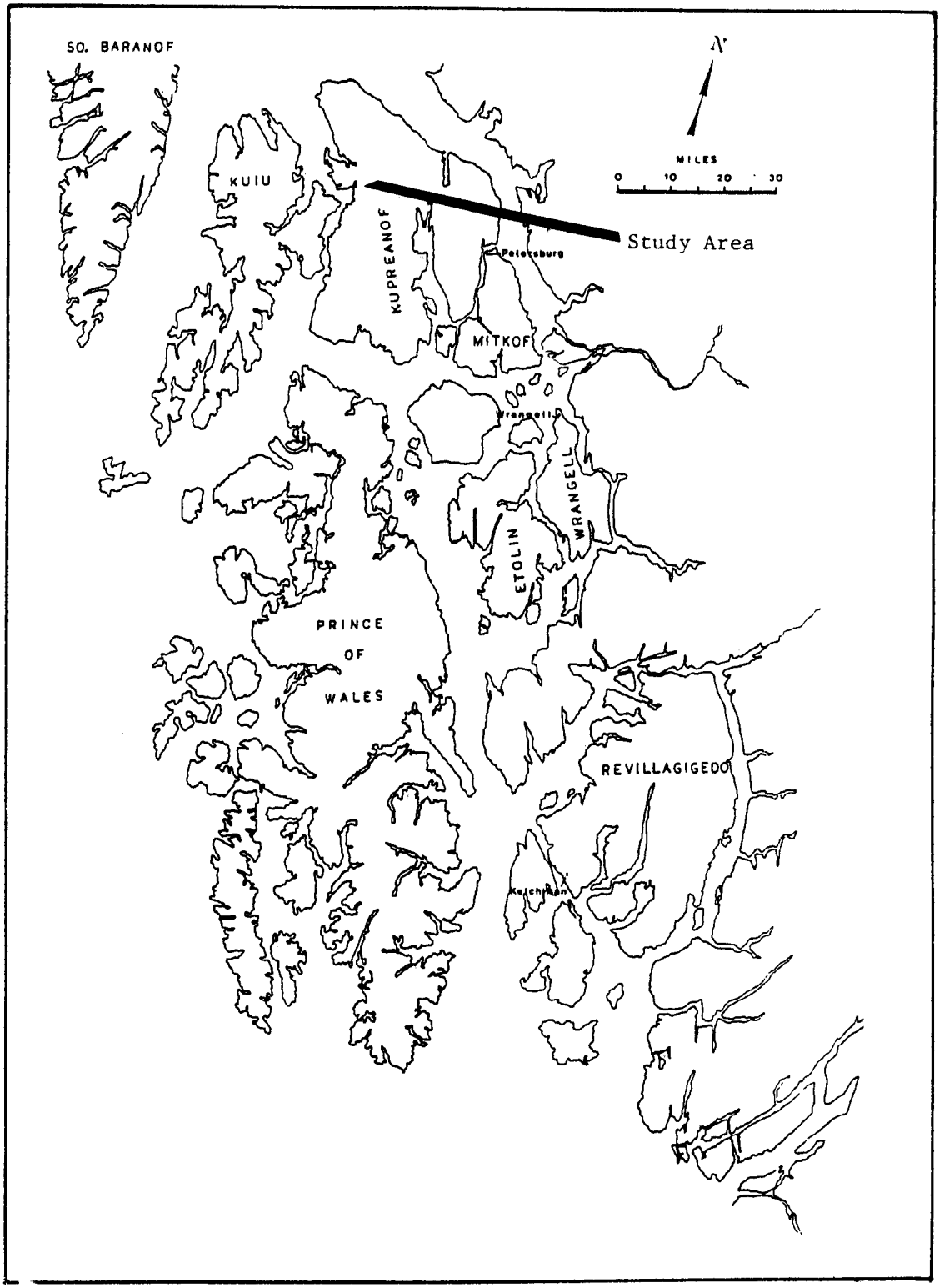

Figure 1. Southern Southeast Alaska, Showing the Location of the Study Area.

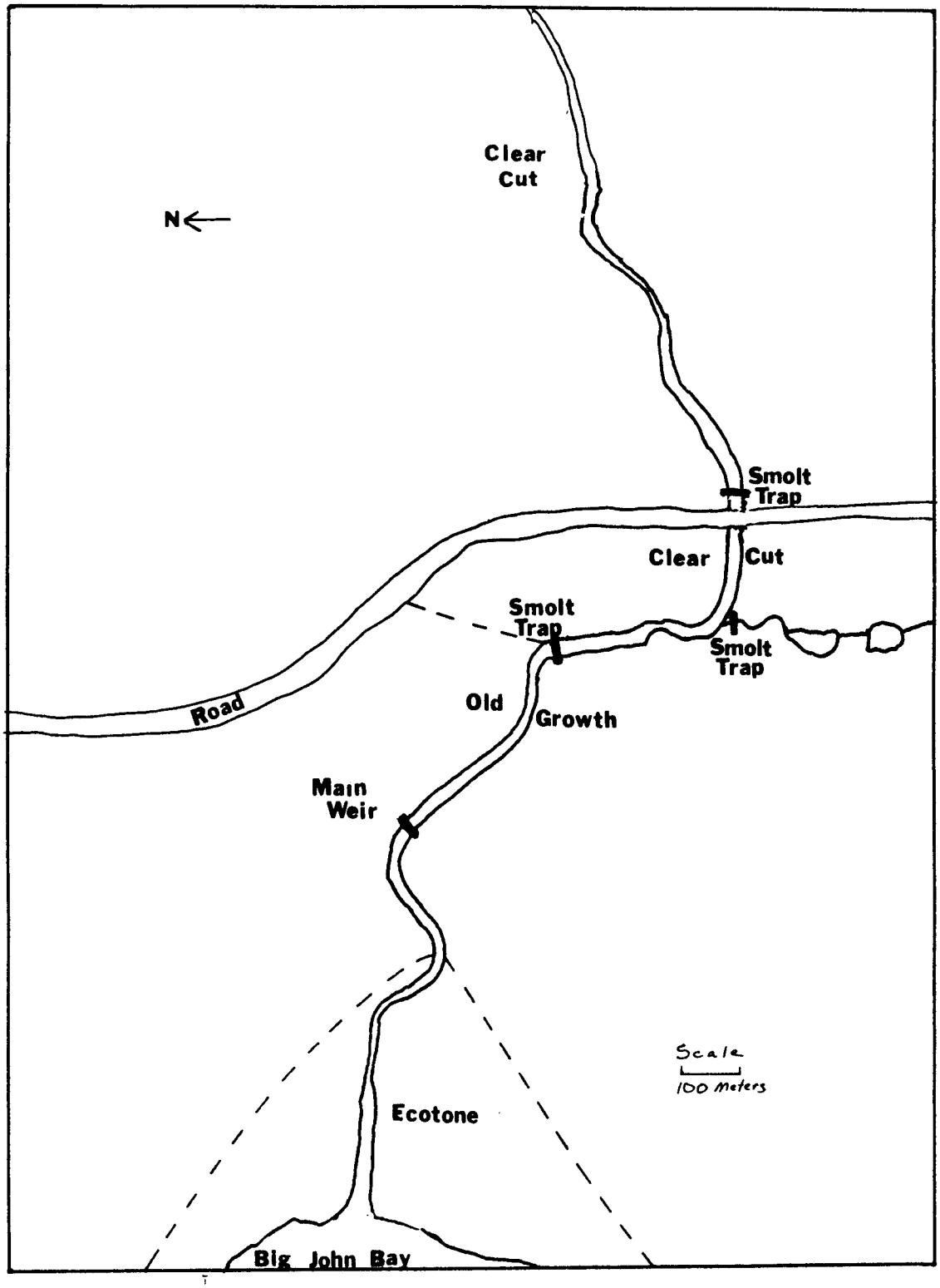

Figure 2. Kake Bake Creek, Kupreanof Island, Showing the Location of Treatments, Weirs, and Traps.

Sampling Methods

Population estimates were done in each reach. Reaches were blocked with 1/4-in mesh seine nets at the upstream and downstream boundaries, and fish were captured with a Smith-Root Type-15-A backpack electric shocker. Because this gear does not work well in saline water, the estuarine reaches were sampled with a beach seine. In reaches with large quantities of debris or large pools, minnow traps were used in addition to shocking to increase the catch. Fish captured in August were given a left- or right-ventral fin clip, indicating which treatment section they were captured in. These marks were used to determine the amount of intrastream migration between August and November. Thereafter, fish captured in November or March were given a mark by removing the tip of the caudal lobe or a small midcaudal punch with a hypodermic needle.

All fish were tranquilized with MS-222 and measured to the nearest 1 mm fork length; representative samples were weighed to the nearest 0.1 gram; scales were taken, and fish were released when recovered. The reach was shocked again after 2-3 hours. Fish caught as a result of the shocking were examined for marks, and a population estimate was calculated using Chapman's modification of the Peterson estimate (Ricker 1985).

Habitat Measurements

Habitat was measured in each reach within each treatment during August and March: (a) mean depth and width, (b) mean velocity, (c) discharge, (d) surface area, (e) volume, and (f) gradient. Habitat types (Bisson et al. 1981) and substrate types were described using the transect method (Johnson and Heifetz 1985). Each pool in the stream was described (Bisson et al. 1981) and measured to determine surface area and volume. The surface area of undercut banks and the volume of large organic debris were measured using the method described by Johnson and Heifetz (1985).

Fish movement within and in and out of the system were monitored by two 2-way migrant weirs from August through November (Figure 2). Smolt production from each treatment section was monitored with fyke nets located at the downstream boundary of the clear-cut section, the outlet of the beaver ponds, and the upper portion of the clear-cut. Fish passing through each weir were measured and given a distinctive fin mark (anal, upper, or lower caudal punch). Scales and weights were collected from a 10% sample of the migrants and all previous fin marks were recorded.

FINDINGS

Population Size

Populations of juvenile coho salmon decreased about 78% between August and March in the old-growth forested and clear-cut logged treatment sections (Table 2). As a result of migration to upstream areas in October and mortality between August and March, nearly all fish in the estuarine area disappeared by March.

Table 2. Mean Number of Juvenile Coho Salmon per 50 m Reach in the Estuarine, Old-Growth Forested, and Clear-Cut Logged Sections of Kake Bake Creek, 1985-1986.

TREATMENT	AUGUST		NOVEMBER		MARCH	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Estuary (n=11)	143.8	33.9	13.1	23.9	1.0	1.6
Old-Growth (n=15)	152.9	56.2	81.1	47.8	23.3	17.2
Clear-Cut (n=13)	133.2	76.8	81.1	60.0	34.9	30.8

Movement of Juveniles

Movement of juvenile coho varied among the treatments. Of the 1,318 fish marked in the estuary during August, 491 were recovered in November. All but 49 of the 491 fish were recovered in the old-growth forested and clear-cut logged sections of the stream (Table 2). Fish marked in the old-growth and clear-cut logged sections moved less; 75% and 95%, respectively, were recaptured where they had been marked.

Movement of Estuarine-Reared Fish

Between mid-August and 30 November, 1,434 fish moved from the estuarine section of Kake Bake Creek to the forested and clear-cut sections. About 50% of these ranged from 45 to 90 mm long (fork length) and originated from the estuarine section of the stream. The fork lengths for the remainder of the fish ranged from 90 to 175 mm, and they were bright silver in coloration. According to Bruce Wing (pers. comm.), some fish carried sea-lice (*Caligus* spp.), indicating a marine origin. Movement of juveniles from the estuary coincided with high flows and high tides; peak immigration occurred on 17 October 1985.

Winter Survival

Preliminary analysis shows that winter-survival rates of juvenile coho salmon (Table 4) were not significantly different (one-way ANOVA; $P<0.05$) in the clear-cut and old-growth sections of the watershed. Future analysis may modify these findings: (1) different age classes of juveniles may differ in survival; (2) large-sized estuarine immigrants were more common in the clear-cut than in the old-growth section; and (3) winter conditions may have been less severe in the clear-cut section: that portion of the stream in the clear-cut had less discharge and more optimal quantities and spacing of habitat.

Smolt Studies

Smolt work is being conducted at the time of this writing and will be reported in future progress reports.

Habitat Studies

As of this writing, new data on habitat is being collected. Completed data and analysis will be reported in future progress reports.

Studies of Preferred Habitat

Preferred habitat studies were elective and were not conducted this year.

ACKNOWLEDGEMENTS

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Table 3. Number of Juvenile Coho Salmon Marked in August and Recaptured in November in the Estuarine, Old-Growth Forested, and Clear-Cut Logged Sections of Kake Bake Creek, 1985.

ORIGIN	Number Marked	TREATMENT WHERE RECOVERED			Total Recovered
		Estuary	Old-Growth	Clear-Cut	
Estuary (n=11)	1318	49(9.9%)	261(53.2%)	181(36.9%)	491(100%)
Old-Growth (n=15)	1675	30(5.2%)	430(74.1%)	120(20.7%)	580(100%)
Clear-Cut (n=18)	1591	2(0.3%)	23(3.8%)	583(95.9%)	608(100%)

Table 4. Mean Survival Rate of Juvenile Coho Salmon per 50 m Reach in the Old-Growth Forested and Clear-Cut Sections of Kake Bake Creek, 1985-1986.

TREATMENT	AUG-NOV		NOV-MAR		AUG-MAR	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Old-Growth (n=15)	0.59	0.38	0.33	0.33	0.20	0.18
Clear-Cut (n=13)	0.55	0.29	0.59	0.56	0.24	0.11

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